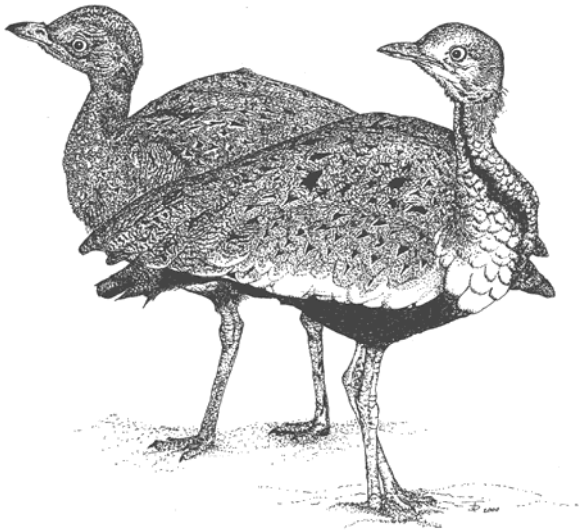
2006 Population Management Plan for the Buff-crested bustard



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AMERICAN ZOO AND AQUARIUM ASSOCIATION

Smithsonian *National Zoological Park*

Recommendations proposed by this PMP are non-binding and participation is voluntary

Executive Summary

Breeding and Transfer Recommendations for BUFF-CRESTED BUSTARD (E*upodotis ruficrista gindiana*)
Population Management Plan for 2006

Report compiled under Population Management 2000, version 1.202

The last Breeding and Transfer Recommendations for this species were completed February 2005.

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Current Population
There are currently 32 animals (16 males; 16 females) at 13 institutions.

The 2006 Population Management Plan (PMP) for buff-crested bustards provides genetic and demographic analysis of the captive population of buff-crested bustards in the United States. The buff-crested bustard PMP includes information that can be used to determine pairings, prevent inbreeding and maintain genetic diversity.

The Gruiformes Taxon Advisory Group has set a target population size for this species of 40-50 specimens although this number can grow if new institutions become interested in the species. Currently, reproduction is being suppressed due to a lack of interested institutions.

Demographic Summary Table:

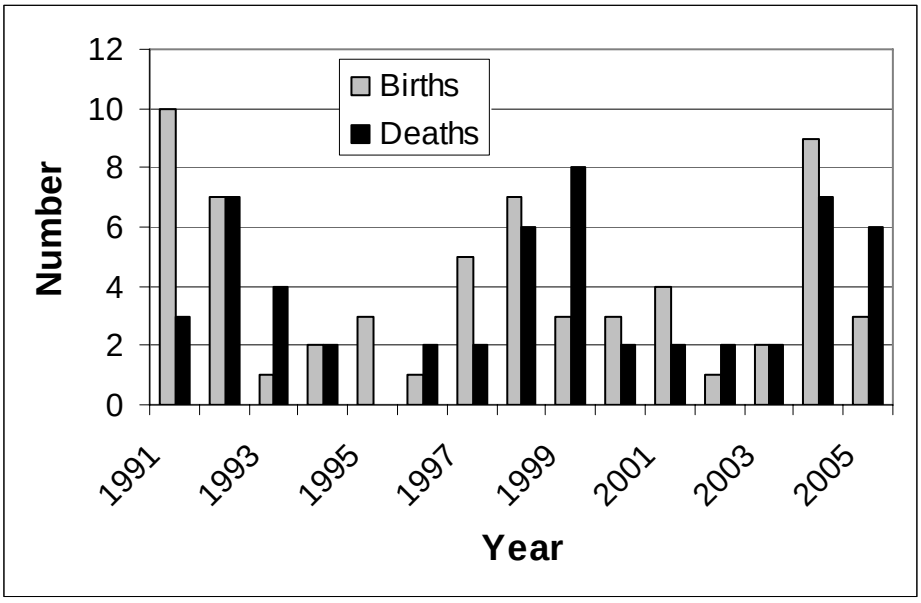
Current size of managed population	32 (16.16.0)
# Specimens excluded from management	0
Mean generation time[1]	8.7 years
Potential population growth rate	1.025
# Births in past year	3
# Deaths in past year	3

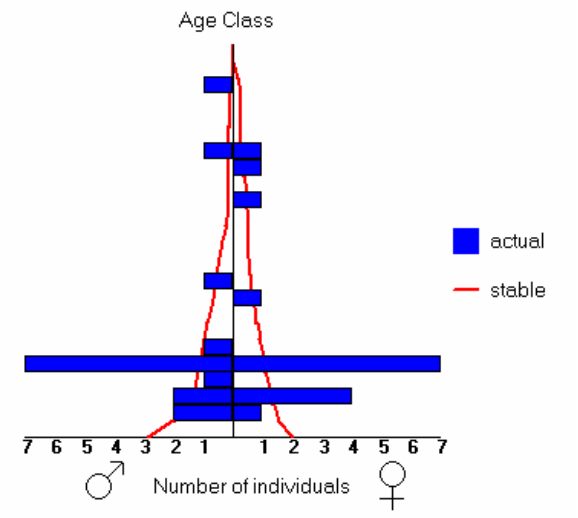
1. Sufficient demographic data are not available to estimate generation lengths from the studbook. Age of first reproduction in the US is 2 years in both sexes and the oldest

known male and female to have bred were 20 year-old birds. Generation length is assumed to be less than the midpoint of these two years (i.e. about 8-9 years).

The number of births and deaths over recent years has fluctuated widely (Figure 1), making it difficult to predict the number of births needed to maintain the population at about 40 birds. The average mortality rate over the last five years has been about 11%. Applying this to the current population of 33 birds gives an expected number of deaths in 2006 of 3 to 4 birds. Therefore, 3 to 4 hatches are needed to maintain the population at about 33 birds. These numbers are based on very small samples and are not particularly reliable.

Fig. 1. Births and deaths of buff crested bustards since 1991





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Genetic Summary Table:

	Current	Potential
Founders	9	11 additional
Founder genome equivalents[3]	4.49	17.98
Founder genome surviving	6.69	17.98
Gene diversity retained[2]	0.889	0.972
Population mean kinship[1]	0.111	0.028
Mean inbreeding	0.032	0.028
Ne / N	0.09	-----
% of pedigree known	88	-----

1. This is a measure of the average relatedness among animals in the population. Wild caught birds are not included. On average, the population is as related as half siblings so the genetic situation is not particularly good. Fortunately, some of the recently imported birds have begun to breed, so the mean kinship should improve in the next few years.
2. 89% of the gene diversity of the wild population is retained in the captive population. Captive breeding goals often set objectives of 90% or higher, so the population is not currently at this level. If genetic management was "ideal", 97% of the wild gene diversity could be retained. Gene diversity increased in 2005 due to the breeding of a new wild caught pair.
3. The founder genome equivalent of 4.49 represents the genetic equivalent of 4.49 wild caught birds. Under ideal genetic management, the potential founder genome equivalent could be as high as 17.98.

Summary of Breeding and Transfer Recommendations

ID	Location	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
310	BIRMINGHM	B03002	M	4	HOLD	BIRMINGHM	BREED WITH	311	
311	BIRMINGHM	B03003	F	4	HOLD	BIRMINGHM	BREED WITH	310	
70	CINCINNAT	204022	F	8	HOLD				
313	CINCINNAT	204021	M	2	HOLD				
6	DALLAS	874884	M	21	HOLD	DALLAS			
20	DALLAS	896584	F	17	HOLD	DALLAS			
295	DALLAS	03E638	M	4	HOLD	DALLAS	BREED WITH	7, 325	
296	DALLAS	03E639	M	4	HOLD	DALLAS	BREED WITH	7, 325	
323	DALLAS	05F486	M	1	SEND TO	SAN ANTON			
325	DALLAS	05F906	F	1	HOLD	DALLAS	BREED WITH	295, 296	
303	DENVER	A02499	M	4	HOLD	DENVER	BREED WITH	304, 305	
304	DENVER	A02500	F	4	HOLD	DENVER	BREED WITH	303	
305	DENVER	A02501	F	4	HOLD	DENVER	BREED WITH	303	
47	FRESNO	6787	F	14	HOLD	FRESNO	DO NOT BREED		
321	FRESNO	250007	M	2	HOLD	FRESNO	DO NOT BREED		
300	HOUSTON	20386	F	4	HOLD	HOUSTON	BREED WITH	324	
324	HOUSTON	22130	M	1	HOLD	HOUSTON	BREED WITH	300	
27	KNOXVILLE	264	F	16	HOLD	KNOXVILLE			
23	SAN ANTON	L01067	M	16	HOLD	SAN ANTON	BREED WITH	298, 314	
297	SAN ANTON	M03017	M	4	HOLD	SAN ANTON	BREED WITH	298, 314	
298	SAN ANTON	M03018	F	4	HOLD	SAN ANTON	BREED WITH	23, 297	
314	SAN ANTON	M04041	F	2	HOLD	SAN ANTON	BREED WITH	23, 297	
277	SD-WAP	801265	M	5	HOLD	SD-WAP	DO NOT BREED		
309	SD-WAP	805018	M	4	HOLD	SD-WAP	BREED WITH	315	
315	SD-WAP	805065	F	2	HOLD	SD-WAP	BREED WITH	309	
319	SD-WAP	804176	F	2	HOLD	SD-WAP	DO NOT BREED		
320	SEA WORLD	BCB002	F	2	HOLD	SEA WORLD	N/A		
294	ST LOUIS	101992	F	4	HOLD				
312	ST LOUIS	103526	M	2	HOLD				

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209	TOLEDO	981630	M	9	SEND TO	COLUMBUS		
301	WILD WRLD	7012	M	4	HOLD	WILD WRLD	BREED WITH	302
302	WILD WRLD	7013	F	4	HOLD	WILD WRLD	BREED WITH	301

BIRMINGHM

Birmingham Zoo
Birmingham, AL

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
310	B03002	M	4	HOLD	BIRMINGHM	BREED WITH	311	
311	B03003	F	4	HOLD	BIRMINGHM	BREED WITH	310	

CINCINNAT

Cincinnati Zoo & Botanical Garden
Cincinnati, OH

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
70	204022	F	8	HOLD	CINCINNATI	DO NOT BREED		
313	204021	M	2	HOLD	CINCINNATI	DO NOT BREED		

DALLAS

Dallas Zoo
Dallas, TX

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
6	874884	M	21	HOLD	DALLAS			
20	896584	F	17	HOLD	DALLAS	DO NOT BREED		Exhibit bird
295	03E638	M	4	HOLD	DALLAS	BREED WITH	325	
296	03E639	M	4	HOLD	DALLAS	BREED WITH	325	
323	05F486	M	1	SEND TO	SAN ANTON			
325	05F906	F	1	HOLD	DALLAS	BREED WITH	295, 296	

DENVER

Denver Zoological Gardens
Denver, CO

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
303	A02499	M	4	HOLD	DENVER	BREED WITH	304, 305	
304	A02500	F	4	HOLD	DENVER	BREED WITH	303	
305	A02501	F	4	HOLD	DENVER	BREED WITH	303	

FRESNO

Chaffee Zoological Gardens of Fresno
Fresno, CA

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
47	6787	F	14	HOLD	FRESNO	DO NOT BREED		
321	250007	M	2	HOLD	FRESNO	DO NOT BREED		

HOUSTON

The Houston Zoo
Houston, TX

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
300	20386	F	4	HOLD	HOUSTON	BREED WITH	324	
324	22130	M	1	HOLD	HOUSTON	BREED WITH	300	

KNOXVILLE

Knoxville Zoological Gardens
Knoxville, TN

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
27	264	F	16	HOLD	KNOXVILLE	N/A		

SAN ANTON

San Antonio Zoological Gardens & Aquarium
San Antonio, TX

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
323		M	1	RECEIVE FROM	DALLAS	BREED WITH	298, 314	
23	L01067	M	16	HOLD	SAN ANTON	BREED WITH	298, 314	
297	M03017	M	4	HOLD	SAN ANTON	BREED WITH	298, 314	
298	M03018	F	4	HOLD	SAN ANTON	BREED WITH	23, 297	
314	M04041	F	2	HOLD	SAN ANTON	BREED WITH	23, 297	

SD-WAP

San Diego Wild Animal Park
Escondido, CA

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
277	801265	M	5	HOLD	SD-WAP	DO NOT BREED		
309	805018	M	4	HOLD	SD-WAP	BREED WITH	315	
315	805065	F	2	HOLD	SD-WAP	BREED WITH	309	
319	804176	F	2	HOLD	SD-WAP	DO NOT BREED		

SEA WORLD

Sea World San Diego
San Diego, CA

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
320	BCB002	F	2	HOLD	SEA WORLD	N/A		

ST LOUIS

Saint Louis Zoological Park
St. Louis, MO

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
294	101992	F	4	HOLD	ST LOUIS	DO NOT BREED		
312	103526	M	2	HOLD	ST LOUIS	DO NOT BREED		

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TOLEDO

Toledo Zoological Gardens
Toledo, OH

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
209	981630	M	9	SEND TO	COLUMBUS			

WILD WRLD

Wildlife World Zoo
Litchfield Park, AZ

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
301	7012	M	4	HOLD	WILD WRLD	BREED WITH	302	
302	7013	F	4	HOLD	WILD WRLD	BREED WITH	301	

COLUMBUS

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
209	981630	M	9	RECEIVE FROM	TOLEDO	N/A		

Appendix 1: Life Table data for males and females

	Males					Females				
Age	Qx	Px	Lx	Mx	Vx	Qx	Px	Lx	Mx	Vx
0	0.370	0.630	1.000	0.000	1.227	0.330	0.670	1.000	0.000	1.198
1	0.120	0.880	0.630	0.000	1.769	0.120	0.880	0.670	0.000	1.593
2	0.210	0.790	0.554	0.080	2.211	0.070	0.930	0.590	0.170	1.769
3	0.100	0.900	0.438	0.150	2.663	0.150	0.850	0.548	0.230	1.799
4	0.000	1.000	0.394	0.360	2.778	0.060	0.940	0.466	0.200	1.766
5	0.090	0.910	0.394	0.420	2.653	0.070	0.930	0.438	0.250	1.679
6	0.000	1.000	0.359	0.700	2.454	0.170	0.830	0.407	0.170	1.626
7	0.100	0.900	0.359	0.470	1.934	0.000	1.000	0.338	0.250	1.610
8	0.170	0.830	0.323	0.190	1.770	0.160	0.840	0.338	0.000	1.483
9	0.000	1.000	0.268	0.230	1.824	0.130	0.870	0.284	0.220	1.743
10	0.080	0.920	0.268	0.400	1.739	0.080	0.920	0.247	0.160	1.710
11	0.170	0.830	0.247	0.090	1.600	0.000	1.000	0.227	0.170	1.622
12	0.200	0.800	0.205	0.460	1.938	0.000	1.000	0.227	0.080	1.457
13	0.500	0.500	0.164	1.220	2.322	0.000	1.000	0.227	0.360	1.381
14	0.000	1.000	0.082	0.000	1.731	0.200	0.800	0.227	0.000	1.138
15	0.000	1.000	0.082	0.250	1.814	0.000	1.000	0.182	0.140	1.284
16	0.000	1.000	0.082	0.330	1.638	0.390	0.610	0.182	0.300	1.426
17	0.000	1.000	0.082	0.500	1.370	0.000	1.000	0.111	0.500	1.491
18	0.000	1.000	0.082	0.000	0.911	0.000	1.000	0.111	0.000	0.994
19	0.000	1.000	0.082	0.000	0.955	0.000	1.000	0.111	0.000	0.997
20	0.000	1.000	0.082	1.000	1.000	0.000	1.000	0.111	1.000	1.000
21	0.000	1.000	0.082	0.000	0.000	0.000	1.000	0.111	0.000	0.000
22	1.000	0.000	0.082	0.000	0.000	1.000	0.000	0.111	0.000	0.000
23	1.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000

Qx = mortality; Px = survival; Lx = cumulative survivorship; Mx = fecundity; Vx = expected future reproduction

Projected population growth rates

Males: r = 0.0464; lambda = 1.0475; R0 = 1.451; T = 8.02

Females: r = 0.0031; lambda = 1.0031; R0 = 1.029; T = 9.39

Appendix 4: Ordered mean kinships

	Males						Females				
Rank	**Stbk#**	**MK**	**Known**	**Age**	**Location**	**Rank**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
1	295	0.0000	100.0	4	DALLAS	1	300	0.0000	100.0	4	HOUSTON
2	296	0.0000	100.0	4	DALLAS	2	302	0.0000	100.0	4	WILD WRLD
3	301	0.0000	100.0	4	WILD WRLD	3	304	0.0000	100.0	4	DENVER
4	303	0.0000	100.0	4	DENVER	4	305	0.0000	100.0	4	DENVER
5	309	0.0000	100.0	4	SD-WAP	5	311	0.0000	100.0	4	BIRMINGHM
6	310	0.0000	100.0	4	BIRMINGHM	6	298	0.0476	100.0	4	SAN ANTON
7	297	0.0476	100.0	4	SAN ANTON	7	314	0.0635	100.0	2	SAN ANTON
8	324	0.0635	100.0	1	HOUSTON	8	315	0.0635	100.0	2	SD-WAP
9	209	0.0655	100.0	9	TOLEDO	9	20	0.0913	100.0	17	DALLAS
10	6	0.0873	100.0	21	DALLAS	10	27	0.0913	100.0	16	KNOXVILLE
11	23	0.0913	100.0	17	SAN ANTON	11	47	0.0913	100.0	14	FRESNO
12	323	0.1191	100.0	1	DALLAS	12	294	0.1191	100.0	4	ST LOUIS
13	277	0.1508	50.0	5	SD-WAP	13	325	0.1191	100.0	1	DALLAS
14	312	0.1667	75.0	3	ST LOUIS	14	70	0.1508	50.0	8	CINCINNAT
15	313	0.1667	75.0	2	CINCINNAT	15	319	0.1667	75.0	2	SD-WAP
16	321	0.1667	75.0	2	FRESNO	16	320	0.1667	75.0	2	SEA WORLD

Mean Kinship (MK) is a measurement of the average relatedness of an individual to all individuals in the living descendant population. The more common the genes of the bird, the more related it is to everyone in the population and the higher its MK. The lower the MK, the less related. By breeding birds with low MK, we can increase the frequency of their genes within the population, thus increasing gene diversity.

Appendix 5: Institutional representatives
Institutions holding animals

BIRMINGHM
Birmingham Zoo
2630 Cahaba Rd.
Birmingham, AL 35223
Phone: (205)879-0409 x251
Email: Tsnyder@birminghamzoo.com
Contact person: Tim Snyder

WILD WRLD
Wildlife World Zoo
Northern Ave. at State Route 303
Litchfield Park, AZ 85340-9466
Phone: (623)935-9453
Email: jackewert@wildlifeworld.com
Contact person: Jack Ewert

FRESNO
Chaffee Zoological Gardens of Fresno
894 W Belmont Ave.
Fresno, CA 93728-2891
Phone: (559)621-5700
Email: Dale.Thompson@fresno.gov
Contact person: Dale Thompson

SD-WAP
San Diego Wild Animal Park
15500 San Pasqual Valley Rd
Escondido, CA 92027
Phone: (619)738-5077
Email: mmace@sandiegozoo.org
Contact person: Mike Mace

SEA WORLD
Sea World San Diego
500 Sea World Dr.
San Diego, CA 92109-7904
Phone: (619)226-3875
Email: Wendy.Turner@seaworld.com
Contact person: Wendy Turner

DENVER
Denver Zoological Gardens
City Park
Denver, CO 80205-4899
Phone: (303)376-4914
Email: jazua@denverzoo.org
Contact person: John Azua

ST LOUIS
Saint Louis Zoological Park
1 Government Dr.
St. Louis, MO 63110-1395
Phone: (314)781-0900 x362
Email: Macek@stlzoo.org
Contact person: Mike Macek

CINCINNAT
Cincinnati Zoo & Botanical Garden
3400 Vine St.
Cincinnati, OH 45220-1399
Phone: (513)475-6153
Email: David.Oehler@fuse.net
Contact person: David Oehler

COLUMBUS
Columbus Zoo and Aquarium
PO Box 400
Powell, OH 43065
Email: Dusty.Lombardi@columbuszoo.org
Contact person: Dusty Lombardi

TOLEDO
Toledo Zoological Gardens
PO Box 140130
Toledo, OH 43614-0801
Phone: (419)385-5721 x2008
Email: Robert.Webster@toledozoo.org
Contact person: Robert Webster

KNOXVILLE
Knoxville Zoological Gardens
P.O. Box 6040
Knoxville, TN 37914
Phone: (865)637-5331 x392
Email: Mark@knoxville-zoo.org
Contact person: Mark Armstrong

DALLAS
Dallas Zoo
650 South R.L. Thornton Freeway
Dallas, TX 75203-3013
Phone: (214)670-6839
Email: cdbrown@mail.ci.dallas.tx.us
Contact person: Chris Brown

HOUSTON
The Houston Zoo
1513 N MacGregor
Houston, TX 77030-1603
Phone: (713)533-6525
Email: Hbailey@houstonzoo.org
Contact person: Hannah Bailey

SAN ANTON
San Antonio Zoological Gardens & Aquarium
3903 N. St. Mary's Street
San Antonio, TX 78212-3199
Phone: (210)734-7184
Email: curbirds@sazoo-aq.org
Contact person: Josef San Miquel